SOUTHWEST RESEARCH INSTITUTE ASSISTANCE TO NASA IN BIOMEDICAL AREAS OF THE TECHNOLOGY UTILIZATION PROGRAM

QUARTERLY PROGRESS REPORT NO. 3
1 March 1967 - 31 May 1967

NASr Contract No. 94(09)
SwRI Project No. 14-1963

Prepared for

Chief, Dissemination Branch, Code (UT)
Technology Utilization Division
Office of Technology Utilization
NASA
Washington, D.C. 20546

SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO HOUSTON

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29B. QPR - 3

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Prepared by:

6 Ray W. Ware, ~~M. D.~~
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San Antonio, Texas 78206

APPROVED:

William E. Cory, Director
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PREFACE

This report documents project activities during the months of March, April, and May, 1967, on NASA Contract NASr-94(09), designated as Southwest Research Institute Project 14-1963. Project team members include personnel from Southwest Research Institute, Baylor University School of Medicine, The University of Texas Medical Branch at Galveston, Rice University, Texas Institute for Rehabilitation and Research, and Tufts Univeristy. Additionally, problems were submitted from the Veterans Administration Southern Research Support Center, Wilford Hall USAF Hospital, and the University of Texas Medical School at San Antonio.

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A. INTRODUCTION

1. General

This project has as its goal in support of NASA's Biomedical Applications Program, the development of methods for effectively transferring the maximum amount of applicable aerospace techology to the fields of medicine and biology, of applying such methods to the accomplishment of as many such transfers as possible and of documenting the results of the project. The basic steps being utilized to accomplish these goals are:

(1) Selection of key consultants at specified medical schools and other biomedical research centers.

(2) Identification of need and problems, pertinent to the biological and medical research community, and likely to be amenable to solution by aerospace developed technology.

(3) Reduction of identified problems to writing, posing them in terms which are meaningful to physical scientists, engineers, and information retrieval specialists.

(4) Identification and evaluation of those items of aerospace technology which may be useful answers to submitted medical and biological problems.

(5) Communication of aerospace derived information to those investigators who originally submitted the problems.

(6) Rendition of assistance as needed to biomedical scientists in order to aid them in applying new aerospace technology effectively in the course of their investigations, thus achieving technology transfers.

(7) Documentation of all stages of development of technology transfers.

(8) Rendition of assistance to NASA in disseminating information about technology transfers.

Information pertaining to each biomedical problem submitted is organized and maintained in the form of a "case history" of that problem.

The biomedical case problem case history file constitutes the major source of information for this and future documentation of the project.

2. Participating Personnel

Southwest Research Institute Biomedical Applications Team:
SwRI Personnel
Ray W. Ware, M.D., Director
Louis S. Berger
Raul San Martin, M.D.
Charles J. Laenger, Sr.

C. W. Hall, M.D., Asst. Professor, Department of Experimental Surgery, Baylor University School of Medicine, Houston, Texas
F. Hermann Rudenberg, Ph.D., Associate Professor, Department of Physiology, The University of Texas Medical Branch, Galveston, Texas
W. W. Akers, Ph.D., Biomedical Engineering Laboratory, Rice University, Houston, Texas
Jack B. Johnson, Ass't. Chief, Biomedical Instrumentation Section, Southern Research Support Center, Veterans Administration, Little Rock, Arkansas

Joe Canzoneri, (VRA), Director, Biomedical Engineering, Texas Institute for Rehabilitation and Research, Houston, Texas
Sanford J. Freedman, Ph.D., (VRA), Neuropsychology Laboratory, Institute for Psychological Research, Tufts University, Medford, Massachusetts

Other Southwest Research Institute Staff Consulted:

Stephen Juhasz, Ph.D., Editor, Applied Mechanics Review
Paul D. May, Ph.D., Senior Research Chemist
Wallace L. Anderson, Ph.D., Senior Research Engineer
Frank C. Milstead, Senior Research Engineer

B. BIOMEDICAL PROBLEMS

1. List of Submitted Problem Statements

Texas Institute for Rehabilitation and Research (VRA Sponsored)

No.	Title
HUV-1	Reduced Workload Environment for Physically Handicapped Patients
HUV-2	Advanced Computer Display and Interface Technology
HUV-3	Computer Scheduling Techniques
HUV-4	Heart Sounds, Interval Analysis
HUV-5	End Tidal Air Sampler
HUV-6	Ambulation Aid
HUV-7	Scheduling for Ward Patients
HUV-8	Mechanisms of Onset of Orthostatic Hypotension
HUV-9	Prosthetic Materials for Urinary Tract
HUV-10	Instrumented Prosthetic Leg
HUV-11	Improved Gas Sample Flow Control and Measurement
HUV-12	Special Automobile Modifications for Disabled Persons
HUV-13	Human Transfer Function Measurements
*HUV-14	Physical Space Utilization
	Rice University
RCU-1	"Artificial Heart" Control System Technology

*Identified during the third-quarter reporting period.

No.	Title
	Veterans Administration Southern Research Support Center
SRS-1	Indirect Measurement of Blood Pressure During Rest and Exercise on Arms and Legs
*SRS-2	Catheter Tip Transducer for Blood Pressure and Flow Measurement
*SRS-3	Locating Tip of Stomach Tube
*SRS-4	Materials Suitable for Dry Electrode Fabrication
*SRS-5	Temperature Regulatory Mechanisms of the Body
*SRS-6	Investigations of Cutaneous Stimuli
	Baylor University Medical School
BLM-1	Noiseless Gas Valves for "Artificial Heart" Use
BLM-2	Support Slings for Postoperative Care of Large Animals
BLM-3	Triggering on R Wave of ECG
BLM-4	Valve for Proportional Gas Flow Control
BLM-5	Transthoracic Energy Coupling Devices
BLM-6	Biocompatible Spray-on Plastics, Impermeable to Bacteria
BLM-7	Telemetry of Cardiovascular Data from Free-Ranging Animals
BLM-8	Miniature Tape Recorder for Biological Data
	The University of Texas Medical Branch, Galveston
GLM-1	Analysis of Transitional Flow-Convection/Diffusion

*Identified during the third-quarter reporting period.

No.	Title
GLM-2	Monitoring of Blood Pressure by Extra-Vascular Sensor, Using Wireless Telemetry of Information
*GLM-3	Determination of Local Blood Flow, Blood Gas Concentration, and Blood pH in Small Portion of an Organ
*GLM-4	Implanted Blood Pressure Transducer
*GLM-5	Chronic Intracranial Pressure Measurement in Man
*GLM-6	A Model Vascular System
*GLM-7	Viscosity Measurement of Minute Samples of Blood
*GLM-8	Computer Program for Electroencephalograph: Period Analysis
*GLM-9	Measurement of Local Tissue Oxygen Consumption In Vivo
*GLM-10	Computer Program for Flame Spectrophotometry
*GLM-11	Elimination of Electrostatic Charge in Experimental Animals
*GLM-12	Computer Selection and Elimination of Artifacts
*GLM-13	Multiple Co-Spectral Density Analysis of Time-Series Data
	Wilford Hall Hospital
*WLH-1	Blood Recirculation Technology
	The University of Texas Medical School at San Antonio
*SNM-1	Enhancement of X-ray Contrast Study Films

*Identified during the third-quarter reporting period.

2. Problem Case Histories

HUV-1

TITLE: Reduced Workload Environment for Physically Handicapped Patients

DATE SUBMITTED: 28 December 1966

SOURCE: Miss Miriam Partridge, Director, Dept. of Physical Therapy, Texas Institute for Rehabilitation and Research

INITIAL DISPOSITION: Applicable technology was disclosed in NASA TND-2641, "Exploratory Study of Man's Self-Locomotion Capabilities with a Space Suit in Lunar Gravity," and TND-3363, "Comparative Measurements of Man's Walking and Running Gaits in Earth and Simulated Lunar Gravity." Direct contact with Langley Research Center was therefore initiated.

COMMUNICATIONS WITH NASA CENTERS:

27 September 1966 Dr. Ware, Mr. Berger, Dr. Vallbona (Director of Research, TIRR), and Dr. Hartwig, NASA consultant, visited Langley Research Center to survey a typical NASA research center in order to orient the Biomedical Applications Team with respect to NASA organization and procedures. During this visit, it was planned to arrange a site visit for the Texas Institute for Rehabilitation and Research staff members who are concerned with this problem.

23 February 1967 Mr. Berger called Mr. Shufflebarger, TU Officer, Langley Research Center, to plan site visit regarding this problem.

13 April 1967 Dr. Ware, and Miss Miriam Partridge and Mr. Joe Canzoneri of Texas Institute for Rehabilitation and Research visited the lunar gravity simulator. Both Miss Partridge and Dr. Ware tried out the 1/6 g simulator. Miss Partridge spent over an hour in the sling suspension system in order to evaluate problems which might be anticipated in applying this technology to handicapped patients. Conference was held with Mr. Amos Spady, Jr., Mr. W. Krasnow and Mr. Don Hughes. Information and sketches were passed to Miss Partridge, the researcher. This site visit was considered to be outstandingly successful from the standpoint of transferring the desired technology. Documenting photographs were taken as illustrated in Section C of this report.

OTHER COMMUNICATIONS:

25 April 1967 Dr. Ware and Mr. Berger called Mr. Canzoneri to inform him of currently appearing literature applicable to this problem (Aerospace Medicine, "Metabolic Rates During Lunar Gravity Simulation," Vol. 38, pp. 380-382, April 1967.)

16 May 1967 During a visit by Mr. Berger to Texas Institute for Rehabilitation and Research, he was informed by Mr. Canzoneri that a grant application based upon technology transferred in answer to this problem statement was in preparation and would be submitted by the end of the month. Information copies of the application were promised.

31 May 1967 A copy of Problem Abstract HUV-10 was mailed to Miss Partridge, as some of the instrumentation sought in HUV-10 could be applied to evaluation of HUV-1.

TECHNOLOGY TRANSFER SITUATION:

Status: minor transfer accomplished*; major potential transfer accomplished.

Projected Significance: major contribution to medical rehabilitation of handicapped persons.**

*The technology made available to this investigator has been used as the basis for preparation of a document (a grant request).

**Accomplishment of a major actual transfer is contingent upon the outcome of the grant request.

HUV-2

TITLE: Advanced Computer Display and Interface Technology

DATE SUBMITTED: 28 December 1966

SOURCE: Dr. C. Vallbona, Associate Professor, Texas Institute for Rehabilitation and Research

INITIAL DISPOSITION:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 31 January 1967
RETURNED FROM SEARCH CENTER: 10 February 1967
RESULTS FORWARDED TO RESEARCHER: 21 February 1967
EVALUATION BY RESEARCHER: 16 May 1967, rated excellent

COMMUNICATIONS WITH NASA CENTERS:

21, 22 March 1967 Dr. Ware and L. Berger discussed this question with TU representatives at Ames Research Center. No directly applicable technology was located.

9 May 1967 Dr. Ware called Mr. Jack Wheeler, TU Officer, Manned Spacecraft Center, who stated that appropriate contacts would be sought at the center.

19 May 1967 L. Berger called Mr. Jack Wheeler and received reference to NASA scientist, Mr. John Overton, at Manned Spacecraft Center. Mr. Overton was called, and tentative arrangements for a site visit were discussed.

24 May 1967 Visit for three TIRR staff members and two members of the Biomedical Applications Team to Manned Spacecraft Center were confirmed with Mr. John Overton for 12 June.

PROBLEM ABSTRACT DRAFT SUBMITTED: 28 May 1967

OTHER COMMUNICATIONS:

7 April 1967 L. Berger discussed the search results with the problem originator during a visit to Texas Institute for Rehabilitation and Research.

8 May 1967 L. Berger had further discussions with the problem originator and Mr. Don Liss, Director, Computer Research, Texas Institute for Rehabilitation and Research, and Mr. Joe Canzoneri.

9 May 1967 Discussions were continued between TIRR researchers, Dr. Ware and L. Berger.

19 May 1967 Mr. Liss reviewed the draft of the problem abstract during a visit of L. Berger to Texas Institute for Rehabilitation and Research. Plans for the coming site visit (MSC) were also discussed.

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for identifying transfer--good.

Projected Significance: useful contribution to medical rehabilitation research.

HUV-3

TITLE: Computer Scheduling Techniques

DATE SUBMITTED: 28 December 1966

SOURCE: Dr. C. Vallbona, Associate Professor, Texas Institute of Rehabilitation and Research

INITIAL DISPOSITION:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 31 January 1967
RETURNED FROM SEARCH CENTER: 10 February 1967
RESULTS FORWARDED TO RESEARCHER: 24 February 1967

COMMUNICATIONS:

7 April 1967 Search returns discussed with originator during visit to Texas Institute for Rehabilitation and Research by L. Berger. Evaluation of search returns not complete as yet.

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for identifying transfer--good.

Projected Significance: useful contribution to medical rehabilitation research and clinical practice.

HUV-4

TITLE: Heart Sounds, Interval Analysis

DATE SUBMITTED: 28 December 1966

SOURCE: Dr. C. Vallbona, Associate Professor, Texas Institute for Rehabilitation and Research

INITIAL DISPOSITION:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 31 January 1967
RETURNED FROM SEARCH CENTER: 10 February 1967
RESULTS FORWARDED TO RESEARCHER: 3 March 1967
EVALUATION BY RESEARCHER: 8 May 1967
Generally negative. No references seem applicable to the problem, but the search has called attention to interesting articles, and several references may be of interest for other purposes.

COMMUNICATIONS:

7 April 1967 Search returns were discussed with problem originator during visit by L. S. Berger to Texas Institute for Rehabilitation and Research.

2 May 1967 Policy of re-searching questions was discussed with Mr. John Canter, Asst. Director, KASC, University of Pittsburgh, by telephone.

8 May 1967 Meeting with problem originator during visit by L. Berger to Texas Institute for Rehabilitation and Research. The problem originator expressed the opinion the the problem search write-up on which the NASA search was based accurately described his intent.

16 May 1967 Letter by L. S. Berger to Mr. Canter planning for further communications regarding additional searching on this question.

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for identifying transfer--poor.

Projected Significance: minor contribution

HUV-5

TITLE: End Tidal Air Sampler

DATE SUBMITTED: 28 December 1966

SOURCE: Dr. C. Vallbona, Associate Professor, Texas Institute for Rehabilitation and Research

INITIAL DISPOSITION:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 31 January 1967
RETURNED FROM SEARCH CENTER: 10 February 1967
RESULTS FORWARDED TO RESEARCHER: 3 March 1967
EVALUATION BY RESEARCHER: 26 April 1967
Search yielded negative results, although several references are of great interest for purposes unrelated to the problem.

COMMUNICATIONS:

17 February 1967 Possible overlap with Midwest Research Institute's Problem KU-2 was investigated by letter from L. Berger.

2 March 1967 Information on three applicable NASA items was received from Mr. D. Bendersky, Project Leader, resulting from Midwest Research Institute's investigation. Possible application of technology is pending further evaluation by Midwest Research Institute.

8 May 1967 Researcher was interviewed by L. Berger during visit to TIRR. The researcher thought that the search statement described his needs accurately, but that the references yielded by the search were too extensive and not pertinent to the problem.

16 May 1967 L. Berger wrote a letter to Mr. John Canter, Assistant Director, KASC, University of Pittsburgh, raising the possibility that this problem be re-searched. No decision regarding a second search has been reached to date.

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for identifying transfer--poor.

Projected Significance: useful contribution.

HUV-6

TITLE: Ambulation Aid

DATE SUBMITTED: 28 December 1966

SOURCE: Dr. C. Vallbona, Associate Professor, Texas Institute for Rehabilitation and Research

INITIAL DISPOSITION:

Since it was known from a visit on 27 September 1966, to Langley Research Center by Drs. Hartwig, Vallbona, Ware and Mr. Berger that potentially applicable technology existed at Langley Research Center, it was decided to postpone further action pending a scheduled visit to the research center.

COMMUNICATIONS WITH NASA CENTER:

23 February 1967 L. Berger called Mr. Shufflebarger, TU Officer, Langley Research Center, to discuss site visit by Texas Institute for Rehabilitation and Research researchers and a member of the SwRI Biomedical Applications Team.

12 April 1967 Potentially applicable technology ("space shoes") at Langley Research Center was evaluated during a visit by two scientists from Texas Institute for Rehabilitation and Research and Dr. Ware. Results of the evaluation were negative.

PROBLEM ABSTRACT DRAFT SUBMITTED: 26 May 1967

OTHER COMMUNICATIONS:

17 February 1967 Overlap information on Midwest Research Institute's Problem KU-9 was requested by letter (L. Berger).

2 March 1967 Letter from Mr. D. Bendersky, Project Leader, stated that Midwest Research Institute's literature search revealed no NASA activity in this area.

13, 14 December 1966 Problem was discussed with problem originator during his visit to SwRI (R. Ware. R. San Martin, L. S. Berger).

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for identifying transfer uncertain.

Projected Significance: useful contribution.

HUV-7

TITLE: Scheduling for Ward Patients

DATE SUBMITTED: 30 January 1967

SOURCE: Miss Frances Brush, Director of Nursing, Texas Institute for Rehabilitation and Research

INITIAL DISPOSITION:

Computer search of NASA data bank; search performed in two parts: part one, identical to search performed on Problem HUV-3; part two, specific to HUV-7.

SEARCH REQUEST SENT TO SEARCH CENTER: 31 January 1967/
23 February 1967

RETURNED FROM SEARCH CENTER: 24 February 1967/
21 March 1967

RESULTS FORWARDED TO RESEARCHER: 24 February 1967/
3 April 1967

EVALUATION BY RESEARCHER: Evaluation of computer returns has been initiated but not completed.

COMMUNICATIONS WITH RESEARCHER:

The problem originator was interviewed on 7 April 1967 and 8 May 1967 concerning evaluation of computer returns.

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for identifying transfer--good.

Projected Significance: useful contribution.

HUV-8

TITLE: Mechanisms of Onset of Orthostatic Hypotension

DATE SUBMITTED: 18 January 1967

SOURCE: J. C. Walker, Ph.D., Directress, Biochemistry Laboratory, Texas Institute for Rehabilitation and Research

INITIAL DISPOSITIONS:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 31 January 1967
RETURNED FROM SEARCH CENTER: 10 February 1967
RESULTS FORWARDED TO RESEARCHER: 3 March 1967
EVALUATION BY RESEARCHER: 10 May 1967; very favorable

COMMUNICATIONS WITH RESEARCHER:

7 April 1967 Dr. Walker was interviewed about the evaluation of the search results by L. Berger during his visit to Texas Institute for Rehabilitation and Research. She stated that she was very pleased with the search results and that the searches completely met her needs. She has not as yet requested any particular references. Applications of search returns have been requested from the problem originator for documentation of the transfer.

TECHNOLOGY TRANSFER SITUATION:

Status: transfer accomplished

Projected Significance: insufficient information to estimate.

HUV-9

TITLE: Prosthetic Material for Urinary Tract

DATE SUBMITTED: 10 February 1967

SOURCE: F. Brantley Scott, M.D., Assistant Professor, Baylor University Medical School, Houston, Texas

INITIAL DISPOSITION:

Computer search of NASA data bank.

SEARCH REQUEST SENT TO SEARCH CENTER: 28 March 1967
RETURNED FROM SEARCH CENTER: 20 April 1967
RESULTS FORWARDED TO RESEARCHER: 27 April 1967
(only two references yielded by search)

PROBLEM ABSTRACT DRAFT SUBMITTED: 29 May 1967

COMMUNICATIONS:

18 May 1967 Dr. San Martin consulted with Dr. Paul May, Senior Research Chemist, Southwest Research Institute, in preparing the problem abstract draft. Dr. May's field of specialization is synthetic polymer chemistry.

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for identifying transfer uncertain.

Projected Significance: useful contribution.

HUV-10

TITLE: Instrumented Prosthetic Leg

DATE SUBMITTED: 21 February 1967

SOURCE: Lewis A. Leavitt, M. D., Chairman, Department of Physical Medicine, Texas Institute for Rehabilitation and Research

INITIAL DISPOSITION:

Selected for biomedical problem abstract preparation.

PROBLEM ABSTRACT DRAFT SUBMITTED: 11 May 1967
DRAFT APPROVED: 19 May 1967
DISSEMINATED: 29 May 1967

COMMUNICATIONS:

7 April 1967 Mr. Berger visited Dr. Peterson at Texas Institute for Rehabilitation and Research to discuss this problem.

18 April 1967 Draft of Problem abstract was forwarded to Dr. Peterson for his criticism.

TECHNOLOGY TRANSFER SITUATION:

Status: applicable technology unidentified; outlook for identification--good.

Projected Significance: useful contribution to medical rehabilitation of handicapped individuals.

HUV-11

TITLE: Improved Gas Sample Flow Control and Measurement

DATE SUBMITTED: 22 February 1967

SOURCE: David Cardus, M. D., Research Associate, Texas Institute for Rehabilitation and Research

INITIAL DISPOSITION:

Computer search of NASA data bank, 22 February 1967

SEARCH REQUEST SENT TO SEARCH CENTER: 28 March 1967
RETURNED FROM SEARCH CENTER: 20 April 1967
RESULTS FORWARDED TO RESEARCHER: 27 April 1967
EVALUATION BY RESEARCHER: not received as yet

COMMUNICATIONS WITH NASA CENTER:

27 March 1967 L. Berger letter to James W. Wiggins, TU Officer, Marshall Space Flight Center, requesting information on Tech. Brief 66-10569, Device Accurately Measures and Records Low Gas-Flow Rates.

30 March 1967 Backup information on Tech. Brief 66-10569, sent by Mr. Wiggins.

11 April 1967 L. Berger wrote letter to Manned Spacecraft Center, Houston, Texas, requesting backup information on NASA Tech. Brief 65-10137, Instrument That Calibrates Low Gas-Rate Flow Meters.

11 April 1967 L. Berger letter to Marshall Space Flight Center requesting backup information on Tech. Brief 66-10036, Flow Meter Measures Low Gas-Flow Rates, and requesting further information about Tech. Brief 66-10569.

19 April 1967 Backup package on TB 65-10137 provided by Mr. John Wheeler, TU Officer, Manned Spacecraft Center.

OTHER COMMUNICATIONS:

7 April 1967 During visit to Texas Institute for Rehabilitation and Research, L. Berger discussed the gas-flow measurement problem with the problem originator, and gave him a copy of Tech. Brief 66-10569.

18 April 1967 Tech. Brief 65-10137 was sent to problem originator.

27 April 1967 Tech Brief 66-10569 and backup material was forwarded to problem originator.

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for identifying transfer--uncertain.

Projected Significance: minor.

HUV-12

TITLE: Special Automobile Modifications for Disabled Persons

DATE SUBMITTED: 22 February 1967

SOURCE: Miss Mary Joyce Newsom

INITIAL DISPOSITION:

It was decided that this problem required further clarification and possible subdividing into several problem areas before beginning formal action.

COMMUNICATIONS WITH NASA CENTERS:

21 March 1967 Mr. G. Edwards, TU Officer, Ames Research Center, gave backup material on special electrical switches (proportional controllers), described in Mr. Minefee's invention disclosures, to Dr. Ware and L. Berger.

8 May 1967 L. Berger, in telephone call to Mr. George Edwards, requested hardware described in Mr. Minefee's inventions. Mr. Edwards advised that he would investigate the matter.

9 May 1967 Dr. Ware called Mr. J. Wheeler, TU Officer, Manned Spacecraft Center, and obtained reference to two NASA researchers, Mr. Van Artsdalen and Mr. Miller, who are involved in simulation work. They were called, and the driver simulation needs existing at TIRR were explained to them.

19 May 1967 L. Berger called Mr. Van Artsdalen and Mr. Miller (MSC). Tentative arrangements were made to visit their facilities, and a reference was obtained to simulation work done by Goodyear in Akron, Ohio.

24 May 1967 Visit for 12 June confirmed (telephone call to Manned Spacecraft Center, L. Berger).

OTHER COMMUNICATIONS:

7 April 1967 L. Berger met with Dr. Spencer, Director, Texas Institute for Rehabilitation and Research and other TIRR staff members (Mr. Canzoneri, Miss Keenan, Mr. Langford) to clarify the problem

statement. It was decided that a schedule of priorities for this research would be set up at Texas Institute for Rehabilitation and Research.

18 April 1967 Backup package on special electrical switches, obtained from Ames Research Center, was sent to Texas Institute for Rehabilitation and Research.

8 May 1967 L. Berger met with Texas Institute for Rehabilitation and Research staff members Langford, Tettamante, Poor, Canzoneri, to discuss research protocol plans, and the program needs for specialized servosystems, motors, and hydraulic assist devices. A visit to Manned Spacecraft Center to investigate their technology was tentatively planned for early June.

TECHNOLOGY TRANSFER SITUATION:

Status: tentatively identified; outlook for accomplishing transfer--good.

Projected Significance: major contribution to medical rehabilitation of disabled persons.

HUV-13

TITLE: Human Transfer Function Measurements

DATE SUBMITTED: 9 March 1967

SOURCE: C. Vallbona, M. D., Associate Professor, Texas Institute for Rehabilitation and Research

COMMUNICATIONS WITH NASA CENTERS:

23 January 1967 Letter to Mr. C. C. Shufflebarger, TU Officer, Langley Research Center, requesting information on subject Tech. Brief (TB 66-10379) in response to Dr. Vallbona's specific questions. (L. Berger)

15 February 1967 Letter from Mr. Shufflebarger to L. Berger reporting that the requested information had been sent to Dr. Vallbona, including a complete description of the system by Mr. James J. Adams who developed it at Langley, and Tech. Notes D-2569, -1952, -2394, and -2177, all providing backup information on subject Tech. Brief.

OTHER COMMUNICATIONS:

30 December 1966 This problem statement arose in connection with a letter from L. Berger to Dr. Vallbona, calling his attention to Tech. Brief 66-10379, Human Transfer Functions Used to Predict System Performance Parameters, which was thought to be of possible interest to him as indicated by the interest profile.

18 January 1967 Dr. Vallbona requested specific information about the Tech. Brief in a letter to L. Berger.

25 April 1967 Call by Dr. Ware and L. Berger to Mr. Canzoneri and Dr. Vallbona with a further reference: Critical Re-evaluation of Human Transfer Function Problem in Aerospace Medicine, Vol. 38, pp. 383-389, April 1967.

8 May 1967 Dr. Vallbona expressed continuing interest in the problem to L. Berger during visit to Texas Institute for Rehabilitation and Research.

TECHNOLOGY TRANSFER SITUATION:

Status: tentatively identified; outlook for accomplishing transfer--uncertain.

Projected Significance: useful contribution.

HUV-14

TITLE: Physical Space Utilization

DATE SUBMITTED: 7 May 1967

SOURCE: Dr. C. Vallbona, Associate Professor, Texas Institute for Rehabilitation and Research

INITIAL DISPOSITION:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 18 May 1967

COMMUNICATIONS:

7 May 1967 Problem was presented verbally by Dr. Vallbona to L. Berger during visit to Texas Institute for Rehabilitation and Research.

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for identifying transfer--uncertain.

Projected Significance: useful contribution.

RCU-1

TITLE: "Artificial Heart" Control System Technology

DATE SUBMITTED: 9 December 1966

SOURCE: Dr. William Akers, Director, Biomedical Engineering Laboratory, Rice University and C. W. Hall, M. D., Assistant Professor, Department of Surgery, Baylor University Medical School, Houston, Texas

INITIAL DISPOSITION:

Selected for Problem Abstract preparation.

COMMUNICATIONS WITH NASA CENTERS:

19 May 1967 Dr. Ware and Dr. C. W. Hall visited Lewis Research Center where applicable technology was discovered. The following NASA personnel participated in a briefing on the subject of artificial heart controls: Mr. Kirby Hiller, Mr. Vernon Gebben and Mr. Mike Crosby.

PROBLEM ABSTRACT DRAFT SUBMITTED TO NASA: 18 May 1967

OTHER COMMUNICATIONS:

9 January 1967 Problem abstract draft sent to Dr. W. W. Akers, Rice University, for references and supplementary information.

25 April 1967 Abstract draft sent to Dr. C. W. Hall, Baylor University Medical School, for additional references.

15 May 1967 Dr. Ware called Dr. C. W. Hall to obtain further reference information.

31 May 1967 Dr. Hartwig requested additional modification of Problem Abstract draft.

TECHNOLOGY TRANSFER SITUATION:

Status: applicable technology tentatively identified; outlook for transfer accomplishment--excellent.

Projected Significance: major contribution to artificial heart research.

SRS-1

TITLE: Indirect Measurement of Blood Pressure During Rest and Exercise on Arms and Legs

DATE SUBMITTED: 3 February 1967

SOURCE: George W. Molnar, Ph. D., Coordinator for Professional Services, Southern Research Support Center, VA Hospital, Little Rock, Arkansas

INITIAL DISPOSITION:

Computer search of NASA data banks

SEARCH REQUEST SENT TO SEARCH CENTER: 24 February 1967 (part 2)
RETURNED FROM SEARCH CENTER: 21 March 1967
RESULTS FORWARDED TO RESEARCHER: 31 March 1967

COMMUNICATIONS WITH NASA CENTERS:

21, 22 March 1967 Dr. Ware and L. Berger investigated this problem during their visit to Ames Research Center. Mr. G. Edwards, TU Officer, provided backup packages on telemetry technology and arranged a visit with Mr. T. Fryer, who described current developments at Ames in miniaturized implantable biotelemetry packages.

OTHER COMMUNICATIONS:

31 January 1967 C. J. Laenger, Southwest Research Institute engineer, discussed problem with the problem originator and Mr. J. Johnson during visit to Southern Research Support Center.

8 February 1967 Mr. C. J. Laenger discussed problem with Mr. Johnson via telephone and arranged for a conferences on specific problems.

17 February L. Berger wrote letter to Midwest Research Institute requesting information concerning possible overlap with their problem KU-4.

28 February 1967 Mr. C. J. Laenger visited Mr. Johnson and the problem originator at Southern Research Support Center and discussed details of the problem, including specific approaches to its solution.

SRS-1 (cont'd)

2 March 1967 Letter from Midwest Research Institute described results of their investigations. Possibilities of overlap are still being followed up.

TECHNOLOGY TRANSFER SITUATION:

Status: tentatively identified; outlook for accomplishing transfer--uncertain.

Projected Significance: useful contribution.

SRS-2

TITLE: Catheter Tip Transducer for Blood Pressure and Flow Measurement

DATE SUBMITTED: 7 March 1967

SOURCE: J. B. Johnson, Assistant Chief, Biomedical Instrumentation Section, VA Hospital, Arkansas

INITIAL DISPOSITION:

Computer search of NASA data bank; this search also covers problems GLM-4 and GLM-5.

SEARCH REQUEST SENT TO SEARCH CENTER: 26 May 1967

COMMUNICATIONS WITH NASA CENTERS:

21, 22 March 1967 Dr. Ware and Mr. Berger investigated this problem during their visit to Ames Research Center. Mr. G. Edwards, TU Officer, provided backup packages on the pressure transducers developed by Mr. G. Coon, researcher at Ames, and also arranged for a meeting with Mr. Coon. In the meeting, Mr. Coon demonstrated his devices and supplied information on current developments in his program to reduce the size of his capacitance pressure transducers still further.

24 May 1967 Dr. Ware called Dr. H. Sandler, Ames Research Center, to make further arrangements on transferring capacitance manometry technology.

29 May 1967 Mr. Berger advised Mr. G. Edwards of the tentatively scheduled visit to Ames Research Center to further the transfer of the capacitance transducers.

PROBLEM ABSTRACT DRAFT SUBMITTED: 25 May 1967 (applicable also to problems GLM-4 and GLM-5).

OTHER COMMUNICATIONS:

28 February 1967 Mr. C. J. Laenger, Senior Research Engineer, Southwest Research Institute, discussed catheter tip transducers during his visit to SRSC with the consultant, Mr. J. Johnson, and Dr. Molnar, a physiologist, SRSC, who is interested in acquisition of data with such devices.

SRS-2 (cont'd)

31 March 1967 Mr. Johnson visited Southwest Research Institute; discussed commercially available catheter tip transducer devices.

TECHNOLOGY TRANSFER SITUATION:

Status: technology tentatively identified; outlook for accomplishing transfer--excellent.

Projected Significance: outstanding contribution to medical research and clinical cardiology.

SRS-3

TITLE: Locating Tip of Stomach Tube

DATE SUBMITTED: 7 March 1967

SOURCE: Julius Wenger, M. D., Assistant Chief Medical Service, VA Hospital, Georgia

INITIAL DISPOSITION:

Computer search of NASA data bank.

SEARCH REQUEST SENT TO SEARCH CENTER: 21 May 1967

PROBLEM ABSTRACT DRAFT SUBMITTED: 26 May 1967

COMMUNICATIONS:

31 March 1967 Mr. J. Johnson visited Mr. C. J. Laenger, Senior Research Engineer at Southwest Research Institute, to discuss the problem.

12 April 1967 Mr. Laenger called the problem originator and requested information on dimensional tolerances and other constraints on the problem solutions. The problem originator furnished the requested information, and also stated that his interest is specifically in acquiring a more sensitive method for locating a foreign ferromagnetic body.

TECHNOLOGY TRANSFER SITUATION:

Status: technology unidentified; outlook for identifying transfer--good.

Projected Significance: minor contribution.

SRS-4

TITLE: Materials Suitable for Dry Electrode Fabrication

DATE SUBMITTED: 7 March 1967

SOURCE: J. B. Johnson, Assistant Chief, Biomedical Instrumentation Section, VA Hospital, Arkansas

INITIAL DISPOSITION:

The importance of available aerospace-derived technology applicable to this problem has been previously established, and sources for this technology are known. It was therefore possible to process this problem by furnishing known applicable literature references to the researcher, and verbally informing him of other pertinent technology.

COMMUNICATIONS WITH NASA CENTERS:

18 April 1967 Reference materials on spray-on electrodes was requested in a telephone call from Dr. Ware to Mr. Clinton Johnson, TU Officer, Edwards Flight Research Center. The material was forwarded to the researcher.

OTHER COMMUNICATIONS:

31 March 1967 Problem originator visited Southwest Research Institute and discussed contributions of Aerospace Technology to electrode fabrication. The effort at development of dry LiCL impregnated Balsa wood electrodes by the USAF School of Aerospace Medicine was discussed.

SRS-5

TITLE: Temperature Regulatory Mechanisms of the Body

DATE SUBMITTED: 29 March 1967

SOURCE: George W. Molnar, Ph. D., Chief, Biophysical Science Section, SRSC, VA Hospital

INITIAL DISPOSITION:

Computer search of NASA data bank.

SEARCH REQUEST SENT TO SEARCH CENTER: 26 May 1967

COMMUNICATIONS:

31 March 1967 Mr. J. Johnson visited Mr. C. J. Laenger, Senior Research Engineer, Southwest Research Institute; discussed problem and clarified the need and interest of problem originator.

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for identifying potential transfer--good.

Projected Significance: useful contribution.

SRS-6

TITLE: Investigations of Cutaneous Stimuli

DATE SUBMITTED: 4 April 1967

SOURCE: Erich A. Pfeiffer, Ph. D., Chief, Biomedical Instrumentation Section, SRSC, VA Hospital

INITIAL DISPOSITION:

Computer search of NASA data bank.

SEARCH REQUEST SENT TO SEARCH CENTER: 18 May 1967

COMMUNICATIONS:

12 April 1967 Mr. J. Johnson discussed problem with Mr. C. J. Laenger, Senior Research Engineer, Southwest Research Institute and obtained a more complete understanding of the interest and need of the problem originator.

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for identifying transfer--uncertain.

Projected Significance: useful contribution.

BLM-1

TITLE: Noiseless Gas Valves for "Artificial Heart" Use

DATE SUBMITTED 26 August 1966

SOURCE: C. W. Hall, M.D., Assistant Professor, Department of Experimental Surgery, Baylor University Medical School, Houston, Texas

INITIAL DISPOSITION:

Because of recent publication of NASA Technology Survey SP 5019, Advanced Valve Technology, search of NASA computer data bank was not indicated. Decision was made to prepare problem abstract.

COMMUNICATIONS WITH NASA CENTERS:

24 February 1967 Dr. Ware called Mr. Clinton Johnson, TU Officer, Edwards Flight Research Center, to seek information on valves mentioned in the NASA Advanced Valve Technology Survey. Mr. Johnson agreed to initiate a search for available examples and additional technical information as available.

22 April 1967 Dr. Ware called Mr. Clinton Johnson to follow up on valve information. Mr. Johnson indicated that the curtain flap proportional valve (illustrated in Fig. 24a, p. 126, SP 5019) was not available at Edwards. He suggested contacting the manufacturer. He felt that the sliding stem proportional valve (illustrated in Fig. 23, p. 125) might be available and promised to attempt to obtain an example of this valve for Dr. Hall's evaluation.

PROBLEM ABSTRACT DRAFT SUBMITTED: 20 December 1966
DRAFT APPROVED: 12 January 1967
DISSEMINATED: 15 February 1967

OTHER COMMUNICATIONS:

9 January 1967 Draft of Problem Abstract sent to Dr. C. W. Hall and Dr. W. W. Akers for review and possible suggested additions.

30 January 1967 Advanced Valve Technology Survey, SP 5019, was reviewed and pertinent chapters marked for Dr. Hall's attention, and copies mailed to Dr. Hall.

TECHNOLOGY TRANSFER SITUATION:

Status: tentatively identified; outlook for accomplishing transfer--good.

Projected Significance: major contribution to artificial heart research.

BLM-2

TITLE: Support Slings for Post-Operative Care of Large Animals

DATE SUBMITTED: 7 February 1967

SOURCE: C. W. Hall, M.D., Assistant Professor, Department of Experimental Surgery, Baylor University Medical School, Houston, Texas

INITIAL DISPOSITION:

Technology possibly applicable to this problem was disclosed in NASA TND-2641, Exploratory Study of Man's Self-Locomotion Capabilities with a Space Suit in Lunar Gravity and TND-3363, Comparative Measurements of Man's Walking and Running Gaits in Earth and Simulated Lunar Gravity. Since a site visit to Langley Research Center was already scheduled in connection with Problem HUV-1, action was postponed until evaluation of sling techniques in use at Langley were made with respect to this problem.

COMMUNICATIONS WITH NASA CENTERS:

12, 13 April 1967 Dr. Ware visited Langley Research Center to inspect the lunar gravity simulator facility primarily to determine applicability of the simulator technique to Problem HUV-1. It appeared that lunar gravity sling techniques might be applicable to the support of large animals.

OTHER COMMUNICATIONS:

10 May 1967 The above information was given to Dr. C. W. Hall, the problem originator, during Dr. Ware's visit to Baylor University Medical School.

19 May 1967 This problem was further discussed with Dr. Hall during his and Dr. Ware's visit to Lewis Research Center. The suggested use of Velcro to prevent slings from slipping posed a problem of method of attachment to the large animals. Dr. Ware suggested that the animal could be prepared in advance by surgical implantation of a patch of Velcro using the velour skin substitute technique developed by Dr. Hall.

BLM-2 (cont'd)

TECHNOLOGY TRANSFER SITUATION:

Status: tentatively identified; outlook for accomplishing transfer--good.

Projected Significance: useful contribution.

BLM-3

TITLE: Triggering on R Wave of ECG

DATE SUBMITTED: 7 February 1967

SOURCE: C. W. Hall, M.D., Assistant Professor, Department of Experimental Surgery, Baylor University Medical School, Houston, Texas

INITIAL DISPOSITION:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 28 March 1967
RETURNED FROM SEARCH CENTER: 20 April 1967
RESULTS FORWARDED TO RESEARCHER: 27 April 1967

COMMUNICATIONS WITH NASA CENTERS:

19 May 1967 Dr. Ware and Dr. C. W. Hall visited Lewis Research Center where additional pertinent technology was discovered in the form of a technique for triggering on R-wave of ECG. It was developed by NASA engineer Vernon D. Gebben, who made prepublication copies of a description of his technique available to the researcher, Dr. Hall.

TECHNOLOGY TRANSFER SITUATION:

Status: tentatively identified; outlook for accomplishment of transfer--excellent.

Projected Significance: useful contribution to artificial heart research.

BLM-4

TITLE: Valve for Proportional Gas Flow Control

DATE SUBMITTED: 7 February 1967

SOURCE: C. W. Hall, M.D., Assistant Professor, Department of Experimental Surgery, Baylor University Medical School, Houston, Texas

INITIAL DISPOSITION:

This problem was originally submitted to indicate the need for stepless proportional control valves in an artificial heart control system as distinct from the requirement for low noise ultrareliable on-off valves discussed in BLM-1. Since the summary of NASA literature available as Survey SP 5019 treated both kinds of valves equivalently, technology applicable to this problem has been sought for simultaneously with that for BLM-1 (q.v.).

BLM-5

TITLE: Transthoracic Energy Coupling Devices

DATE SUBMITTED: 7 February 1967

SOURCE: C. W. Hall, M. D., Assistant Professor, Department of Experimental Surgery, Baylor University Medical School, Houston, Texas

INITIAL DISPOSITION:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 28 March 1967
RETURNED FROM SEARCH CENTER: 20 April 1967
RESULTS FORWARDED TO RESEARCHER: 27 April 1967

COMMUNICATIONS:

17 February 1967 Overlap identified with Midwest Research Institute's problem UM-3.

2 March 1967 Letter from Mr. Bendersky, Project Leader, Midwest Research Institute Biomedical Applications Team, referred to possibly pertinent work on energy cells conducted at Jet Propulsion Laboratory and suggested NASA Resident Officer, John C. Drane, as the appropriate contact for the follow-up.

27 April 1967 Backup package on NASA brushless DC motors was sent to researcher, Dr. C. W. Hall.

TECHNOLOGY TRANSFER SITUATION:

Status: no definite transfer identified; outlook for identifying transfer--good.

Projected Significance: major contribution to artificial heart research.

BLM-6

TITLE: Biocompatible Spray-On Plastics, Impermeable to Bacteria

DATE SUBMITTED: 7 February 1967

SOURCE: C. W. Hall, M.D., Assistant Professor, Department of Experimental Surgery, Baylor University Medical School, Houston, Texas

INITIAL DISPOSITION:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 28 March 1967
RETURNED FROM SEARCH CENTER: 20 April 1967
RESULTS FORWARDED TO RESEARCHER: 27 April 1967

COMMUNICATIONS:

Potentially applicable technology was discovered in the form of a research contract at NASA Manned Spacecraft Center, Houston, for development of edible food covering films. Although none of the films developed before termination of the project were directly applicable, commercial sponsorship of further work in this area was obtained by the contractor. Negotiations are now under way with the commercial sponsor to obtain permission to evaluate more recently developed plastic films which have already been shown to be biocompatible. A sample of one of these films sprayed on to nylon velour was provided to the researcher, Dr. C. W. Hall, on 14 April 1967.

TECHNOLOGY TRANSFER SITUATION:

Status: tentatively identified; outlook for accomplishment of transfer--excellent.

Projected Significance: major contribution to artificial heart research.

BLM-7

TITLE: Telementry of Cardiovascular Data from Free-Ranging Animals

DATE SUBMITTED: 7 February 1967

SOURCE: C. W. Hall, M.D., Assistant Professor, Department of Experimental Surgery, Baylor University Medical School, Houston, Texas

INITIAL DISPOSITION:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 24 February 1967 (same as Part I, GLM-2)
RETURNED FROM SEARCH CENTER: 21 March 1967
RESULTS FORWARDED TO RESEARCHER: 27 April 1967

COMMUNICATIONS WITH NASA CENTERS:

27 April 1967 Dr. Ware and Mr. Berger visited Ames Research Center where backup packages on NASA telemetry developments were obtained and sent to the researcher, Dr. C. W. Hall.

OTHER COMMUNICATIONS:

17 February 1967 Overlap with Midwest Research Institute, Problem KU-4 was identified.

2 March 1967 A letter from Mr. Bendersky, Director of Midwest Research Institute Biomedical Applications Team, disclosed their results on the Problem KU-4 and made reference to NASA Technology Utilization Report No. ST-5023, Medical and Biological Applications for Space Technology, by stating that although there are several telemetry systems on the commercial market which have evolved from systems developed for NASA, the systems were not being offered at competitive prices for a small number of channels.

NOTE: The US Air Force Aeromedical Research Laboratory, Holloman Air Force Base, New Mexico, is presently sponsoring contracted research for development of telemetry techniques for use on free ranging chimpanzees. Relevant information may become available later.

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for transfer identification--good

Projected Significance: useful contribution to artificial heart research.

BLM-8

TITLE: Miniature Tape Recorder for Biological Data

DATE SUBMITTED: 22 February 1967

SOURCE: Dr. L. Lamb, Baylor University Medical School, Houston, Texas

INITIAL DISPOSITION:

At the time of receipt of this problem, potentially applicable technology was known to exist at Edwards Flight Test Center in the form of a miniature multichannel biologic data tape recorder in use by Dr. Roman for evaluation of physiologic performance of aerospace pilots.

COMMUNICATIONS WITH NASA CENTERS:

24 February 1967 Dr. Ware called Mr. Clinton Johnson, TU Officer, Edwards Flight Research Center regarding this problem. Mr. Johnson began to assemble technical information available on the miniature personal tape recorder used in the pilot data enhancement system by NASA investigator, Major James A. Roman.

15 March 1967 Dr. Ware called Dr. C. W. Hall to pass on information received from Mr. Johnson about the NASA tape recorder and to call his attention to current literature including Roman, Older, and Jones, Flight Research Program: Medical Monitoring of Navy Carrier Pilots in Combat, Aerospace Medicine, Vol. VII, pp. 133-139, February 1967.

25 April 1967 Dr. Ware called Dr. C. W. Hall to verify that the problem originator, Dr. L. Lamb, had received the available information concerning the NASA personal tape recorder developed and fabricated by Air Research Manufacturing Division, Garrett Company.

TECHNOLOGY TRANSFER SITUATION:

Status: applicable technology identified; outlook for accomplishment of transfer--good.

Projected Significance: useful contribution to heart research.

GLM-1

TITLE: Analysis of Transitional Flow-Convection/Diffusion

DATE SUBMITTED: 14 February 1967

SOURCE: H. G. Swann, Ph.D., Professor of Physiology, University of Texas Medical Branch at Galveston, Galveston, Texas

INITIAL DISPOSITION:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 23 February 1967
RETURNED FROM SEARCH CENTER: 21 March 1967
RESULTS FORWARDED TO RESEARCHER: 18 April 1967
EVALUATION BY RESEARCHER: 10 May 1967:
very favorable

COMMUNICATIONS:

15 January 1967 Dr. Ware interviewed Dr. Swann to round out details concerning this problem before submission as computer search.

24 April 1967 Letter received from Dr. Swann expressing his appreciation for the information transferred.

10 May 1967 Dr. Ware and Mr. Berger visited the University of Texas Medical Branch, Galveston, and interviewed Dr. Swann concerning his intended application of the information returned. Dr. Swann stated that the information had been instrumental in his decision not to undertake further research in the area of analysis of transitional flow in view of the substantial amount of information revealed by the computer search. Dr. Swann felt that the information received was most useful and that it allowed him to turn his attention to other pressing matters.

TECHNOLOGY TRANSFER SITUATION:

Status: applicable technology identified, transfer accomplished and documented.

Projected Significance: minor contribution to physiology research.

GLM-2

TITLE: Monitoring of Blood Pressure by Extra-Vascular Sensor, Using Wireless Telemetry of Information

DATE SUBMITTED: 16 February 1967

SOURCE: C. E. Hall, Ph.D., Professor of Physiology, University of Texas Medical Branch, Galveston, Texas

INITIAL DISPOSITION:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 24 February 1967
(Parts 1 & 2)
RETURNED FROM SEARCH CENTER: 21 March 1967
RESULTS FORWARDED TO RESEARCHER: 18 April 1967
EVALUATION BY RESEARCHER: 10 May 1967
Evaluation favorable. Search provided partial solution to problem.

COMMUNICATIONS WITH NASA CENTERS:

21, 22 March 1967 Dr. Ware and L. Berger investigated this problem during their visit to Ames Research Center. Mr. G. Edwards, TU Officer, provided backup packages on telemetry technology, and arranged a visit with Mr. T. Fryer, Ames Research Center scientist, who described current developments in miniaturized implantable bio-telemetry packages.

18 April 1967 Backup packages from Ames were sent to problem originator.

OTHER COMMUNICATIONS:

17 February 1967 L. Berger wrote a letter to Midwest Research Institute requesting information concerning possible overlap with their problem KU-4.

2 March 1967 Letter from Midwest Research Institute described results of their investigations. Possibilities of overlap are still being followed up.

20 April 1967 Problem originator sent supplementary information, noting that the application to small mammals, e.g., a rat, was not sufficiently emphasized in his problem statement.

2 May 1967 Telephone call by L. Berger to Mr. Canter, Assistant Director, KASC, University of Pittsburgh, discussing the question of repeat searching of an already searched problem. It was noted that this service is included in the search fee.

10 May 1967 Applicable NASA technology and the search applications were further discussed by the problem originator with Dr. Ware and L. Berger during their trip to the Medical School.

16 May 1967 Letter to Mr. Canter requesting further communication about possibility of re-searching this problem, and requesting two references: A63-23506, A Microwatt VHF Telemetry System for Implanatation in Small Animals; A65-10725, Biophysical Monitoring of Experimental Animals. ↑ Supplied by KASC 7/5-

17 May 1967 Letter from problem originator requesting six references:

N6213733--A Transducer for the Continuous External Measurement of Arterial Blood Pressure

A65-26600--Concerning Certain Methodological and Technical Problems Posed by Rocket Experiments Involving Animals supplied by KASC 7/5-

N64-27840--A Method of Continuous Registration of Local Cerebral Blood Flow in Acute and Chronic Experiments

N65-32277--Development of a Blood Pressure Transducer for the Temporal Artery

N65-11900--Instrument for Recording the Pulse Waves and Determining the Blood Pressure in Animals

A63-19640--The Development of an Implantable, Nonocclusive, Non-Invasive Blood Pressure Measuring System

supplied 7/5-

In addition, he will himself obtain the following references: A65-81057, a Progress Report on Radio Telemetry from Outside the Body and A66-81864, Telemetry of Blood Pressure in Free-Ranging Animals Via an Intravascular Gauge.

TECHNOLOGY TRANSFER SITUATION:

Status: tentatively identified; outlook for accomplishing transfer--excellent.

Projected Significance: useful contribution to physiology research.

GLM-3

TITLE: Determination of Local Blood Flow, Blood Gas Concentration, and Blood PH in Small Portion of an Organ

DATE SUBMITTED: 9 March 1967

SOURCE: Dr. F. H. Rudenberg, Associate Professor of Physiology, University of Texas Medical Branch, Galveston, Texas

INITIAL DISPOSITION:

Computer search of NASA data bank

SEARCH REQUEST SENT TO SEARCH CENTER: 26 May 1967

COMMUNICATIONS WITH NASA CENTERS:

The contact with NASA research centers that is relevant to this problem is identical to the histories of the NASA Research Center contracts described under Problems GLM-4, GLM-5, and SRS-2.

OTHER COMMUNICATIONS:

18 April 1967 Ames Research Center backup package on small pressure transducers developed by Mr. Grant Coon was sent to problem originator by L. S. Berger.

TECHNOLOGY TRANSFER SITUATION:

Status: unidentified; outlook for identifying transfer--good.

Projected Significance: useful contribution to physiology research.

GLM-4

TITLE: Implanted Blood Pressure Transducer

DATE SUBMITTED: 9 March 1967

SOURCE: Dr. F. H. Rudenberg, Associate Professor of Physiology, University of Texas Medical Branch, Galveston, Texas

INITIAL DISPOSITION:

Computer search of NASA data bank; this search also covers Problems GLM-5 and SRS-2.

SEARCH REQUEST SENT TO SEARCH CENTER: 26 May 1967 (same as SRS-2, GLM-5)

COMMUNICATIONS WITH NASA CENTERS:

21, 22 March 1967 Dr. Ware and Mr. Berger investigated this problem during their visit to Ames Research Center. Mr. G. Edwards, TU Officer, provided backup packages on the pressure transducers developed by Mr. G. Coon, researcher at Ames, and also arranged for a meeting with Mr. Coon. In the meeting, Mr. Coon demonstrated his devices and supplied information on current developments in his program to reduce the size of his capacitance pressure transducers still further.

24 May 1967 Dr. Ware called Dr. H. Sandler, Ames Research Center, to make further arrangements on transferring capacitance manometry.

29 May 1967 Mr. Berger advised Mr. G. Edwards of the tentatively scheduled visit to Ames Research Center to further the transfer of the capacitance transducers.

PROBLEM ABSTRACT DRAFT SUBMITTED: 25 May 1967 (same as SRS-2, GLM-5)

OTHER COMMUNICATIONS:

18 April 1967 Ames' backup package on miniaturized pressure transducers was sent to problem originator.

GLM-4 (cont'd)

10 May 1967 Dr. Ware and L. Berger visited problem originator and further explained details of construction and performance characteristics of Mr. Coon's family of capacitance devices.

TECHNOLOGY TRANSFER SITUATION:

Status: tentatively identified; outlook for accomplishing transfer--excellent.

Projected Significance: major contribution to manometry problems in medicine.

GLM-5

TITLE: Chronic Intracranical Pressure Measurement in Man

DATE SUBMITTED: 9 March 1967

SOURCE: Dr. F. H. Rudenberg, Associate Professor of Physiology, University of Texas Medical Branch, Galveston, Texas

INITIAL DISPOSITION:

The history of this problem is in all particulars the same as the history of Problem GLM-4 (q.v.).

GLM-6

TITLE: A Model Vascular System

DATE SUBMITTED: 9 March 1967

SOURCE: Robert N. Cooley, M.D., Professor and Chairman, Department of Radiology, University of Texas Medical Branch, Galveston, Texas

INITIAL DISPOSITION:

Computer search of NASA data bank was deferred until after direct contact with Lewis Research Center because it was understood that NASA research personnel there had utilized models of the cardiovascular system and were familiar with the literature.

COMMUNICATIONS WITH NASA CENTERS:

21 April 1967 Dr. Ware and Mr. Berger visited Ames Research Center where Mr. George Edwards, TU Officer, Ames Research Center, cited two reports of interest in connection with cardiovascular modeling. These were NASA Contractor Reports Nos. 162 and 214 prepared by the Vidya Corporation.

26 May 1967 Dr. Ware called Mr. Kirby Hiller, Lewis Research Center, to continue discussion initiated during site visit on 19 May. Mr. Hiller indicated that although the mathematical models which he had utilized were not reduced to hardware form, hardware models potentially applicable to this problem were in use at the Cleveland Clinic.

TECHNOLOGY TRANSFER SITUATION:

Status: technology tentatively identified; outlook for accomplishment of transfer--excellent.

Projected Significance: useful contribution to artificial heart research.

GLM-7

TITLE: Viscosity Measurement of Minute Samples of Blood

DATE SUBMITTED: 17 May 1967

SOURCE: Dr. F. H. Rudenberg, Associate Professor, University of Texas Medical Branch, Galveston, Texas

Problem not processed during reporting period.

GLM-8

TITLE: Computer Program for Electroencephalograph: Period Analysis

DATE SUBMITTED: 17 May 1967

SOURCE: Dr. F. H. Rudenberg, Associate Professor, University of Texas Medical Branch, Galveston, Texas

Problem not processed during reporting period.

GLM-9

TITLE: Measurement of Local Tissue Oxygen Consumption In Vivo

DATE SUBMITTED: 17 May 1967

SOURCE: Dr. F. H. Rudenberg, Associate Professor, University of Texas Medical Branch, Galveston, Texas

Problem not processed during reporting period.

GLM-10

TITLE: Computer Program for Flame Spectrophotometry

DATE SUBMITTED: 17 May 1967

SOURCE: Dr. F. H. Rudenberg, Associate Professor, University of Texas Medical Branch, Galveston, Texas

Problem not processed during reporting period.

GLM-11

TITLE: Elimination of Electrostatic Charge in Experimental Animals

DATE SUBMITTED: 17 May 1967

SOURCE: Colin G. MacDiarmid, Ph. D., Research Scientist, University of Texas Medical Branch, Galveston, Texas

Problem not processed during reporting period.

GLM-12

TITLE: Computer Selection and Elimination of Artifacts

DATE SUBMITTED: 18 May 1967

SOURCE: Colin G. MacDiarmid, Ph. D., Research Scientist, University of Texas Medical Branch, Galveston, Texas

Problem not processed during reporting period.

GLM-13

TITLE: Multiple Co-Spectral Density Analysis of Time-Series Data

DATE SUBMITTED: 18 May 1967

SOURCE: Colin G. MacDiarmid, Ph. D., Research Scientist, University of Texas Medical Branch, Galveston, Texas

Problem not processed during reporting period.

WLH-1

TITLE: Blood Recirculation Technology

DATE SUBMITTED: 2 May 1967

SOURCE: Major Roger Breslau, Vascular Surgery Department, Wilford Hall Hospital, San Antonio, Texas

INITIAL DISPOSITION:

Selected for biomedical problem abstract preparation

COMMUNICATION:

23 May 1967 Dr. Ware made telephone call to problem originator, Dr. Breslau, to clarify the problem and to get further specific information on this problem.

TECHNOLOGY TRANSFER SITUATION

Status: applicable technology unidentified; outlook for identification--excellent.

Projected Significance: major contribution to clinical medicine and surgery.

SNM-1

TITLE: Enhancement of X-ray Contrast Study Films

SYNOPSIS:

During a tour of the facilities of the University of Texas Medical School at San Antonio, Dr. Ware disclosed to Dr. Peter Zanca (Chairman, Radiology Department), the technology developed by Jet Propulsion Laboratories for digital processing and enhancement of television or other digitized images. Dr. Zanca immediately expressed interest in evaluating this process on a series of X-ray films taken during his research on slow intravenous drip methods for contrast study in cholangiography and renography.

COMMUNICATIONS WITH NASA CENTERS:

25 April 1967 Dr. Ware called Dr. R. Nathan at Jet Propulsion Laboratories to Discuss Dr. Zanca's request. Dr. Nathan expressed his willingness to process, on a pilot basis, the aforementioned X-ray photographs.

8 May 1967 The X-ray films were mailed directly to Dr. Nathan.

OTHER COMMUNICATIONS:

25 April 1967 Dr. Ware called Dr. Peter Zanca to notify him of Dr. Nathan's willingness to process his X-ray photographs.

2 May 1967 Dr. Ware telephoned Dr. Peter Zanca to make final arrangements for sending the set of X-ray films to Jet Propulsion Laboratories for digital processing and enhancement. Dr. Zanca also promised to send reprints describing his research to Dr. Nathan.

TECHNOLOGY TRANSFER SITUATION:

Status: potential transfer accomplished.

Projected Significance: useful contribution to both clinical radiology and research in X-ray techniques.

REVERSE PROBLEM CASE HISTORY

DATE IDENTIFIED: 31 October 1966

SOURCE: Southwest Research Institute Biomedical Applications Team

INITIAL DISPOSITION:

Disclosed informally to personnel at three NASA research centers.

DESCRIPTIVE SUMMARY:

31 October 1966 Dr. Spencer presented his staff of the Texas Institute for Rehabilitation and Research to Drs. Hartwig and Ware and San Martin. The day was spent in orientation conferences with individual Texas Institute for Rehabilitation and Research researchers for the purpose of orienting the Biomedical Applications Team as to the mission and interest profile of Texas Institute for Rehabilitation. It was during a tour of laboratory facilities that Mr. Thorkild Engen gave a demonstration of his orthotics research. Upon witnessing the function of Mr. Engen's special four-way valve used to control opposing pneumatic artificial muscles to obtain finely controlled motion in two planes, it was felt that the demonstrated technology might be applicable to problems of mobility in pressure suit design and to "man amplifier" research.

18 January 1967 Dr. Ware and Mr. Berger disclosed the Engen valve-muscle substitute development at Texas Institute for Rehabiliation and Research to Mr. C. Raines, Manned Spacecraft Center, Houston, and made arrangements for him to receive reprints describing the development so that he could reverse transfer" potential.

24 February 1967 Dr. Ware called Mr. Clinton Johnson, TU Officer, Flight Research Center, Edwards Air Force Base, California, to disclose the possible reverse transfer.

28 March 1967 Dr. Ware called Mr. H. C. Vykukal, Ames Research Center, to disclose the Engen valve-artificial muscle development. Mr. Vykukal expressed interest and further indicated that pressure suit joints presently under development at Ames Research Center might be applicable to the orthotics research of Mr. Engen and others at Texas Institute for Rehabilitation and Research. Telephone conversations were scheduled between Mr. Engen and Mr. Vykukal in order to explore the possibility of a visit.

REVERSE PROBLEM CASE HISTORY (cont'd)

30 March 1967 Mr. L. S. Berger contacted Mr. Joe Canzoneri concerning the potential reverse transfer. Arrangements were made for Mr. Engen and Mr. Vykukal to schedule a visit for interchange of information.

25 April 1967 Dr. Ware and Mr. Berger called Mr. Canzoneri and Dr. C. Vallbona to discuss the potential reverse transfer progress.

8 May 1967 Mr. L. S. Berger met with Mr. Engen and explained to him the steps that had been taken at Ames Research Center toward arranging a conference. Mr. G. Edwards was called, and arrangements were made for a telephone conference between Mr. Engen and Mr. Vykukal.

TECHNOLOGY TRANSFER SITUATION:

Status: technology has been identified at Texas Institute for Rehabilitation and Research which may be applicable to NASA pressure suit research.

Projected Significance: uncertain, pending evaluation by NASA scientists.

3. Problem Abstracts Accepted

BIOMEDICAL PROBLEM ABSTRACT

"This problem abstract is designed to call to the attention of NASA personnel (and others who have agreed to participate) significant barriers that impede the progress of biomedical research and health care. The purpose is to bring to bear on these problems the expertise that resides in NASA. If you feel you can make a contribution, please communicate your suggestions to the Technology Utilization Officer at your installation. Also, alert him to any suggestions which can constitute inventions so that patent application may be made. Thank you".

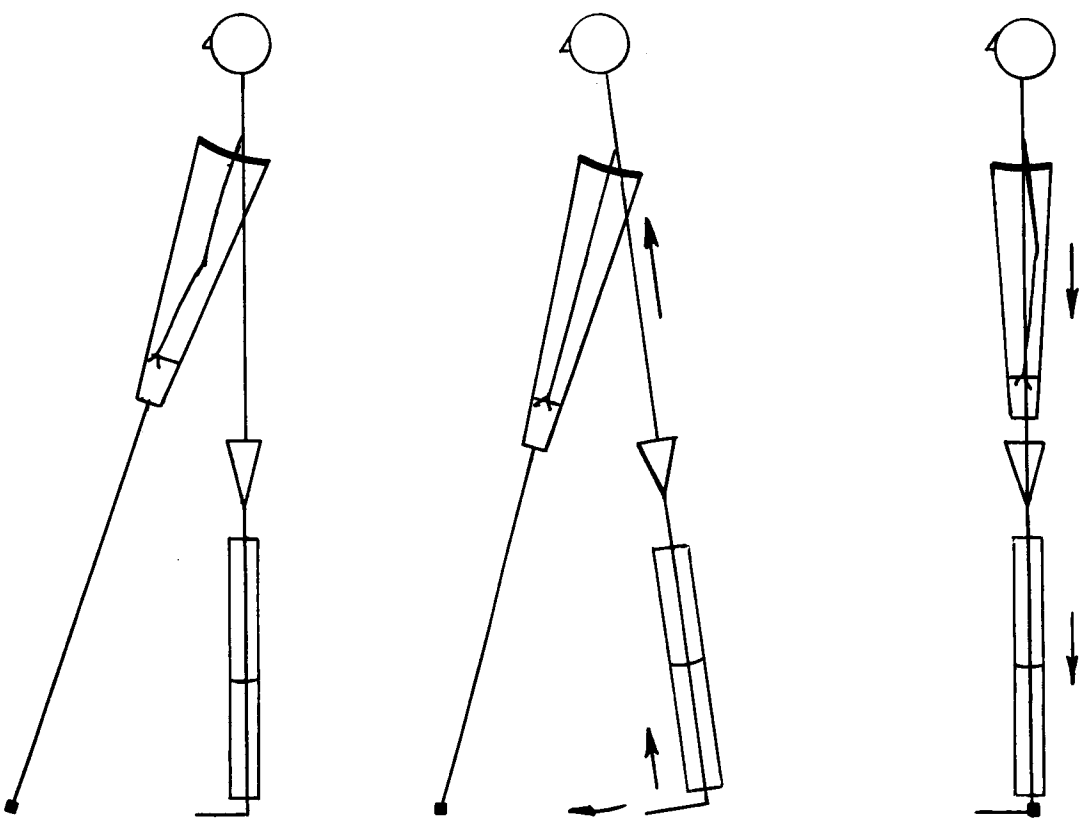
May 1967 HUV-6

POWERED ASSIST DEVICE FOR WALKING

PREPARED FOR NASA

SOUTHWEST RESEARCH INSTITUTE

8500 Culebra Road -:- San Antonio, Texas 78206



ND COMMENTS ON BACK PAGE

BIOMEDICAL PROBLEM ABSTRACT

"This problem abstract is designed to call to the attention of NASA personnel (and others who have agreed to participate) significant barriers that impede the progress of biomedical research and health care. The purpose is to bring to bear on these problems the expertise that resides in NASA. If you feel you can make a contribution, please communicate your suggestions to the Technology Utilization Officer at your installation. Also, alert him to any suggestions which can constitute inventions so that patent application may be made. Thank you".

May 1967

HUV-9

PREVENTION OF ARTIFICIAL URINARY BLADDER ENCRUSTATION

By

Telephone: Area Code 512 — OV 4-2000

References:

1. Berman, Henry I., "Urinary Diversion in Treatment of Carcinoma of Bladder," The Surgical Clinics of North America, Vol. 45, No. 6, December 1965.

2. Blum, Skemp, and Reiser, "Silicone Rubber Ureteral Prosthesis," The Journal of Urology, Vol. 90, No. 3, September 1963.

3. Elliot, S., "Urinary Calculus Disease," The Surgical Clinics of North America, Vol. 45, December 1965.

RSM/RWW

Source: F. Brantley Scott, M.D.
Assistant Professor
Texas Institute for Rehabilitation
and Research
Houston, Texas

AND COMMENTS ON BACK PAGE

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March 1967 HUV-10

INSTRUMENTED ARTIFICIAL LEG

PREPARED FOR NASA

By

SOUTHWEST RESEARCH INSTITUTE

Telephone: Area Code 512 — OV 4-2000

angle of flexion or extension, the moment and duration of the contact of the heel and toe of the artificial limb with the ground, and the dynamical variables associated with these motions.

For studies performed while the amputee still is using the interim artificial leg, the auxiliary instrumentation which processes and telemeters or records the sensed signals does not need to satisfy the more restrictive requirements on size, weight, volume, etc., posed by the design of a final artificial structure.

Aerospace-oriented research may have produced technology which could be the basis for generation of an experimental instrumented artificial leg: techniques of sensing pressure, temperature, etc., at multiple points on a surface, accelerometry and goniometry techniques, and miniature recording, telemetry or television devices. The instrumented leg, adaptable by means of a socket individually molded to a given patient's stump, would allow medically desirable early walking activity (with minimum risk of tissue damage) as well as an accurate, objective evaluation of the patient's functional capability.

References:

Wilson, A. B., Jr., Limb Prosthetics Today. Physical Therapy 44:435-69, June 1964.

Burgess, E. M. and Romano, R. L., New Day for Leg Amputees. Rehab. Rec. 6:8-11, 1965.

Wilson, A. Bennett, Jr., Prosthetics and Orthotics Research in the United States. Rehab. Lit. 24:98-107, April 1963.

Redhead, R. G., Symposium: Recent Trends in Limb Fitting. Recent Developments in Prosthetics. Proc. Roy. Soc. Med. 59:3-5, January 1966 (HMC)

Gilpin, R. E., The Contribution of Research to Prosthetic Services. Med. Serv. J. Canada, 19:727-46, October 1963. (HMC)

RWW/LSB

Source: Lewis A. Leavitt, M. D., Chairman
Dept. of Physical Medicine
Texas Institute for Rehabilitation
and Research
Houston, Texas

AND COMMENTS ON BACK PAGE

4. General Reference Material Sent Texas Institute for Rehabilitation and Research

In accordance with the interest profile generated for Texas Institute for Rehabilitation and Research, the following reference material was identified as relevant and forwarded to Mr. Joe Canzoneri for dissemination to the appropriate researcher:

Description	Date Sent
Selcted Listings of TU Publications (Tech. Briefs through December 65)	30 November 1966
Medical and Biological Applications of Space Telemetry, SP 5023	
The Electromagnetic Hammer, SP 5034	
Selected Shop Techniques, SP 5010	
Bibliography on Welding Methods, SP 5024	
Plating Cu on AL, SP 5025	
Metal-forming Techniques, SP 5017	
Selected Welding Techniques, Part II SP 5009	
Reliable Electrical Connections, SP 5002	
Welding for Electronic Assemblies, SP 5011	
Minutes--Aluminum Welding Symposium (Marshall Space Flight Center) October 13, 1964	30 November 1966
Information on Ordering of Tech. Briefs	30 December 1966
General reference on information theory: IEEE Spectrum, January 1965, R. T. James, Data Transmission--The Art of Moving Information	3 March 1967

Description	Date Sent
Backup packages on Ames accelerometer	18 April 1967
Backup packages on the Ames pressure transducer (Mr. Coon)	18 April 1967
JPL report on Enhancement Techniques for X-rays	18 April 1967
Information (obtained from Mrs. H. Chiaruttini) on commercial manufacturer of NASA-developed sight switch	18 April 1967

C. TRANSFER IDENTIFICATION

1. Summary of Transfer Categories

This section summarizes the detailed status reports presented for each biomedical problem in Section A4 (Problem Case Histories).

(1) Actual Transfers Accomplished

(a) GLM-1 (for titles of these problems see Section A3)

(b) HUV-1 (Part I), photographs on pages 78 through 84 taken during a Langley site visit, show Texas Institute for Rehabilitation and Research researchers and the director of the Southwest Research Institute Biomedical Applications Team being briefed on the reduced gravity simulator by NASA personel, and also show evaluation of the technology by Miss Miriam Partridge, Department of Physical Therapy, Texas Institute for Rehabilitation and Research, Houston, Texas (for further details, see Problem Case History).

(2) Potential Transfers Accomplished

(a) HUV-1 (Part II)

(b) HUV-8

(c) SNM-1

(3) Transfers Tentatively Identified

(a) HUV-12

(b) HUV-13

(c) RCU-1

(d) SRS-1

(e) SRS-2

(f) BLM-1

(g) BLM-2

(h) BLM-3

(i) BLM-6

(j) BLM-8

(k) GLM-2

(l) GLM-4

(m) GLM-6

2. Photographs of Site Visit (Regarding HUV-1 Transfer) to Langley Research Center

Photo No.	Legend
1	Preparation of the sling support system evaluation test: Miss Miriam Partridge, Department of Physical Therapy, Texas Institute for Rehabilitation and Research, Houston, Texas; Mr. Amos A. Spady, Jr., NASA Langley Research Center.
2	System briefing Group left to right: Mr. Sapdy, Mr. Frank G. Read (NASA) and Mr. Joseph Canzoneri, III., Texas Institute for Rehabilitation and Research; in sling, Miss Partridge
3	Running
4	Falling
5	Jumping
6	Back flip
7	Group, left to right: Mr. Spady, Mr. Canzoneri, Ray W. Ware, M.D., Director, Southwest Research Institute Biomedical Applications Team, Mr. Read, and Miss Lynn Stark (NASA)

PHOTO NO. 1

PHOTO NO. 2

PHOTO NO. 3

PHOTO NO. 4

PHOTO NO. 5

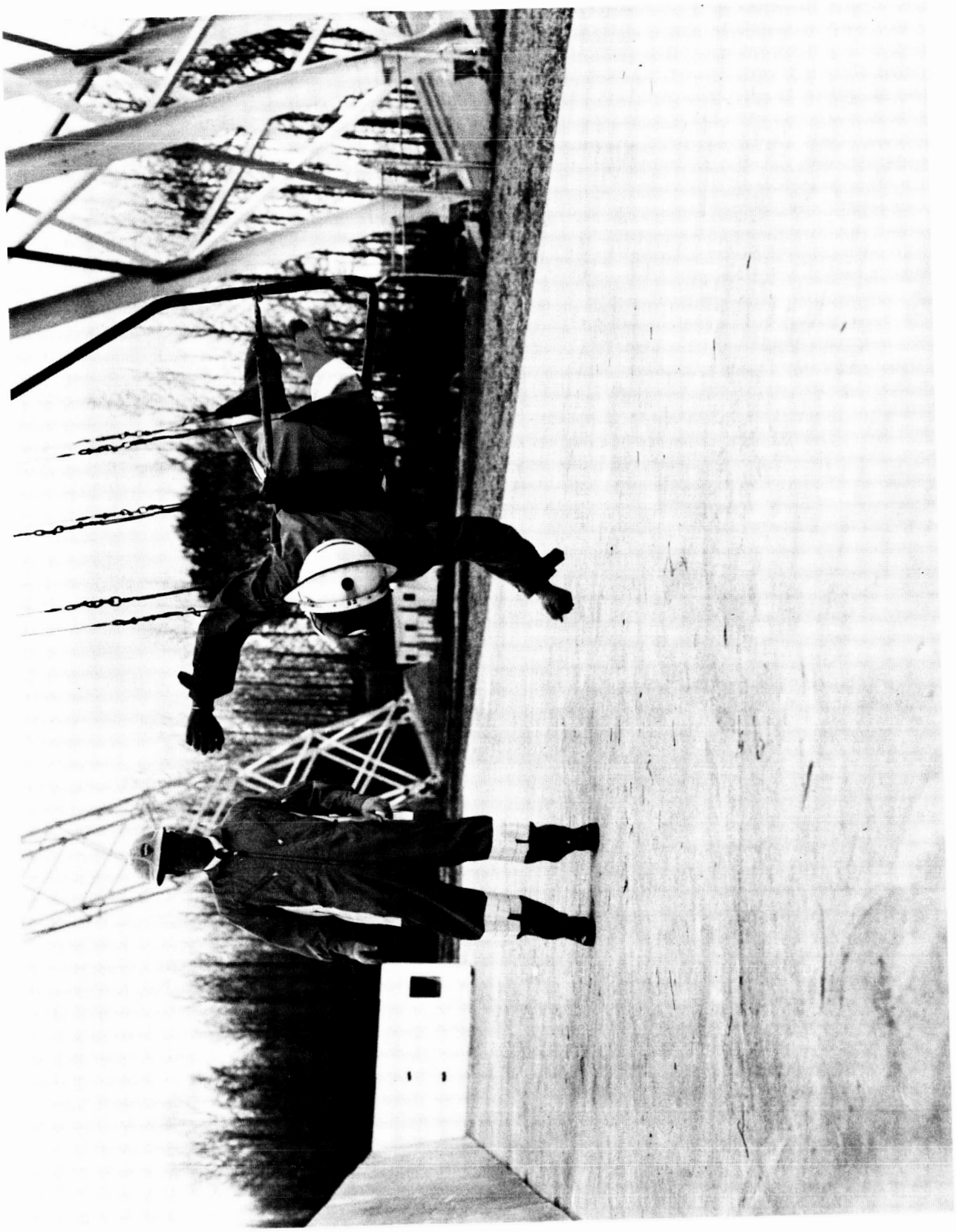

PHOTO NO. 6

PHOTO NO. 7

D. SPEECHES AND PUBLICATIONS

No speeches nor publications were presented during this period.

E. CONTRIBUTIONS TO THE TRANSFER PROCESS

1. Summary

A small percentage of the project time is formally devoted to studies pertaining to the information transfer processes, including development of a pilot system tailored specifically to the storage and retrieval of information in the biomedical-physical science area. A member of the Southwest Research Institute Biomedical Applications Team (L. Berger) consulted with an Institute expert on information handling, attended a conference on this topic, and continued compiling a bibliographical file of pertinent literature in this area.

2. Consultation

On 11 April 1967, Dr. Stephen Juhasz, Editor, Applied Mechanics Review, a staff member of Southwest Research Institute and internationally recognized expert on information handling, was interviewed concerning the state-of-the-art of the subject area. Particular emphasis was placed on analyzing, indexing, and retrieval processes. A number of references were obtained from Dr. Juhasz for further study, as well as references to two research specialists in this area: Professor W. T. Lehmann, Chairman, Department of Linguistics, the University of Texas, Austin, Texas, and Professor A. Oettinger, Applied Mathematics and Linguistics, Harvard University, Cambridge, Massachusetts. It is planned to communicate with these experts after further study of the referenced material.

3. Meetings

At the Second Conference on Electronic Information Handling, sponsored by the Knowledge Availability System Center, University of Pittsburgh, and held April 12 through 14, 1967 at the Flying Carpet Motor Lodge in Pittsburgh, Pennsylvania, papers were presented which dealt particularly with the testing and evaluation aspects of information handling. It appears that emphasis in information handling research is shifting from matters chiefly concerning hardware and machine systems to investigations which are increasingly exploring the needs, characteristics, and idiosyncrasies of the information retrieval system users. It seems to be of limited usefulness and questionable validity to test and evaluate an information handling system in terms of only the hard- and software of the system without broadening the base of analysis to include the interaction between the system and the persons who originate, store, recover, and use the material of interest.

4. References

A list of study references is being compiled, and it is planned in working with these references to apply their contributions specifically to the field of transfer of information in the biomedical-technical area. The following references have been obtained:

(1) On Retrieval System Theory, B. C. Vickery, Butterworth & Co., Ltd., 1961.

(2) An Outline of a Theory of Semantic Information, R. Carnap and Y. Bar-Hillel, Technical Report No. 247, Research Laboratory of Electronics, MIT, Cambridge, Mass., October 27, 1952.

(3) A Scientific Theory of Classification and Indexing and Its Practical Applications, J. E. L. Farradane, Jour. of Documentation, Vol. 6, No. 2, June 1950.

(4) A Scientific Theory of Classification and Indexing: Further Considerations, J. E. L. Farradane, Jour. of Documentation, Vol. 8, No. 2, June 1952.

(5) Compiling a Technical Thesaurus, T. L. Gillum, Jour. of Chemical Documentation, January 1964.

(6) Practical Aspects Concerning the Development and Use of ASTIA's Thesaurus in Information Retrieval, J. F. Caponio and T. L. Gillum, Jour. of Chemical Documentation, Janurary 1964.

(7) Indexing Process Evaluation, C. L. Bernier, Am. Documentation, January 1965.

(8) Reasoning Foundations of Medical Diagnosis, R. S. Ledley and L. B. Lusted, Science III, Vol. 130, No. 3366, July 1959.

(9) A Structure of "Semantic Coding," A Review, B. C. Vickery, Am. Documentation, Vol. 10, 1959.

(10) Storage and Retrieval of Information by Means of the Association of Ideas, M. Taube and associates, Am. Documentation, Vol. 6, No. 1

(11) Current Research and Development in Scientific Documentation, No. 14, National Science Foundation Office of Science Information Service, (NSF-66-17), 1966.

(12) Assessing Technology Transfer, R. L. Lesher and G. J. Howick, NASA SP-5067, 1966.

(13) Conflicting Ideas Trouble Information System Plans, Scientific Research, Vol. 1, No. 3, March 1966.

(14) Comparative Indexing: Terms Supplied by Biomedical Authors and by Document Titles, C. G. Schultz, W. L. Schultz, and R. H. Orr, Am. Documentation, Vol. 16, No. 4 October 1965.

(15) An Experiment in Automatic Indexing, F. J. Damerau, Am. Documentation, Vol. 16, No. 4, October 1965.

(16) An Experiment Comparing Key Words Found in Indexes and Abstracts Prepared by Humans with those in Titles, Am. Documentation, April 1965.

(17) Information Science-Fiction or Fact? F. Pohl, Am. Documentation, Vol. 16, No. 2, April 1965.

(18) A Note on the Pseudo-Mathetmatics of Relevance, M. Taube, Am. Documentation, Vol. 16, No. 2, April 1965.

(19) The Distribution of Term Usage in Manipulative Indexes, N. Houston and E. Wall, Am. Documentation, Vol. 15, April 1964.

(20) Roles and Links - or Forward to Cutter, S. Artandi and T. C. Hines, Am. Documentation, Vol. 14, January 1963.

(21) MIT Technical Information Project, M. M. Kessler, Physics Today, March 1965.

(22) A Bibliographic Search by Computer, S. C. Brown, Physics Today, May 1966.

(23) Debate on Preprint Exchange, Physics Today, June 1966.

(24) Is the Literature Worth Retrieving? S. Goudsmit, Physics Today, September 1966.

F. PROJECTIONS FOR THE NEXT QUARTER

Acquisition of additional personnel for part or full-time assignment to the project is anticipated in proportion to the increasing work load as the program matures. The additional use of one person full time at the technician level and one person half-time at the professional biologist level is anticipated for the next quarter.

The addition of new user organizations will be conditional upon availability of additional personnel and approval of the sponsor.

As indicated in Section D, a significant amount of information has been collected and collated about the theoretical considerations of the information transfer process. During the next quarter, we wish to prepare a theoretical paper on storage and retrieval of interdisciplinary information in the biomedical and physical science areas. It is intended that the paper be suitable for submission to an appropriate journal for publication.